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“Knowledge is such a treasure which cannot be stolen”



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**IS : 3919 - 1966**  
**( Reaffirmed 1999 )**

*Indian Standard*

**METHODS FOR SAMPLING  
COTTON FABRICS FOR DETERMINATION  
OF PHYSICAL CHARACTERISTICS**

**( Second Reprint JANUARY 2000 )**

**UDC 677.21.064 : 620.113.4**

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**BUREAU OF INDIAN STANDARDS**  
**MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG**  
**NEW DELHI 110002**

**AMENDMENT NO. 3   APRIL 2000**

**TO**

**IS 3919 : 1966   METHODS FOR SAMPLING OF  
COTTON FABRICS FOR DETERMINATION OF  
PHYSICAL CHARACTERISTICS**

( *Page 4, Table 1* ) — Under 'LIMITS OF ERROR OF MEAN (PERCENT)' against weight, substitute '6', '4', and '2' *for* '15', '10' and '5' respectively.

( TX 01 )

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Reprography Unit, BIS, New Delhi, India

**AMENDMENT NO. 1      FEBRUARY 1968**  
**TO**  
**IS : 3919-1966 METHODS FOR SAMPLING COTTON**  
**FABRICS FOR DETERMINATION OF**  
**PHYSICAL CHARACTERISTICS**

**Corrigendum**

*( Page 7, third line from bottom ) — Substitute ' $(\bar{x} + k\bar{R})$ ' for ' $(\bar{x} - k\bar{R})$ '.*

**AMENDMENT NO. 2      JULY 1979**  
**TO**  
**IS : 3919 - 1966   METHODS FOR SAMPLING**  
**COTTON FABRICS FOR DETERMINATION OF**  
**PHYSICAL CHARACTERISTICS**

**Addenda**

( *Page 5, clause 4.3.1* ) — Add the following new clauses after 4.3.1 and renumber the subsequent clauses accordingly:

**‘4.4** In case the lot is not in the form of bales or cases but offered as pieces as such, the number of pieces to be selected at random from a lot for testing for a particular characteristic shall be equal to the number of tests required to be carried out according to 3.

**4.4.1** To ensure the randomness of selection of pieces, the procedure as given in IS : 4905-1968\* shall be followed. The procedure for sampling shall be simple random sampling or systematic sampling as given in 3.1 or 3.3 respectively of IS : 4905-1968\*.’

( *Page 5, foot-note* ) — Add the following new foot-note:

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‘\*Methods for random sampling.’

# *Indian Standard*

## METHODS FOR SAMPLING OF COTTON FABRICS FOR DETERMINATION OF PHYSICAL CHARACTERISTICS

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# *Indian Standard*

## METHODS FOR SAMPLING COTTON FABRICS FOR DETERMINATION OF PHYSICAL CHARACTERISTICS

### 0. FOREWORD

**0.1** This Indian Standard was adopted by the Indian Standards Institution on 22 December 1966, after the draft finalized by the Sampling Methods Sectional Committee had been approved by the Textile Division Council.

**0.2** The increase in indigenous production and export of cotton fabrics has made it imperative to evolve sound sampling procedures for objective and economic evaluation of physical characteristics of cotton fabrics. For this purpose, extensive amount of information had been collected from the different textile mills and research organizations in the country and the inherent variability of various characteristics ascertained. This standard recommends the number of tests as obtained on the basis of the resulting data for determining various characteristics with a specified degree of accuracy.

**0.3** In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960\*.

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### 1. SCOPE

**1.1** This standard prescribes the methods for sampling of cotton fabrics for determination of physical characteristics, namely, ends, picks, width, length, thickness, weight, breaking load and bursting strength. It specifies the number of tests that should be made for each characteristic. It also lays down the criteria for ascertaining the conformity of the fabrics to the specified requirements for the characteristics.

### 2. TERMINOLOGY

**2.0** For the purpose of this standard, the following definitions shall apply.

**2.1 Bale (or Case)** — A number of pieces of cotton fabrics packed in a form convenient for transit.

**2.2 Breaking Load** — The maximum load (or force) supported by a specimen in a tensile test carried to rupture. It is commonly expressed in kilograms or in pounds.

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\*Rules for rounding off numerical values (*revised*).

**2.3 Bursting Strength** — The force required to rupture a fabric by distending it with pressure applied at right angles to the plane of the fabric. It is expressed in terms of force per unit area, for instance, kg per cm<sup>2</sup>.

**2.4 Consignment** — A quantity of fabrics delivered to one buyer against one despatch note.

**2.5 Cotton Fabric** — A term which covers all types of cotton cloth or cloth-like textile material independent of construction or method of manufacture.

**2.6 Ends** — The threads which lie along the length of the fabric as woven.

**2.7 Limit of Error of Mean** — The maximum difference between the sample mean and its true value that would be obtained if all the units in the lot were tested.

**2.8 Lot** — All pieces of fabric of the same type and quality and belonging to the same consignment.

**2.9 Mean** — The sum of the observations divided by the number of observations ( *see* Appendix A ).

**2.10 Picks** — The weft or filling yarn which lie across the length of the fabric.

**2.11 Piece** — A customarily accepted continuous unit length.

**2.12 Range** — The difference between the largest and the smallest observations in the sample ( *see* Appendix A ).

NOTE — In case the number of test results are ten or more, they shall be divided into subgroups of five test results each by taking them consecutively in the same order as obtained. The range of each subgroup shall then be determined with a view to obtaining the mean range ( *see* 2.13 ).

**2.13 Mean Range** — The mean of a set of ranges calculated for subgroups in the sample ( *see* 2.12 and Appendix A ).

**2.14 Sample** — Collection of pieces of fabric selected for inspection from a lot.

**2.15 Test Specimen** — A specific portion of the fabric selected from the piece for performing a single test.

### 3. NUMBER OF TESTS

**3.1** The minimum number of tests to be made for determination of various characteristics of fabrics in a lot shall depend upon the accuracy with which the characteristics are to be determined. Table 1 gives the number of tests for the fabrics manufactured in the country for determination of ends, picks.

width, length, thickness, weight, breaking load and bursting strength for varying limits of error.

**TABLE 1 NUMBER OF TESTS**

( Clause 3.1 )

CHARACTERISTIC	LIMITS OF ERROR OF MEAN ( PERCENT )				
	3	4	5	6	8
Ends Picks Width Length	10	5	—	—	—
Weight	15	10	5	—	—
Thickness Breaking load Bursting strength	30	20	15	10	5

**NOTE**— Where the number of tests have become too small, they have not been specified.

**3.2** Unless otherwise agreed to between the buyer and the seller, the number of tests corresponding to 3 percent error for ends, picks, width and length ; 4 percent for weight, 6 percent for thickness and 8 percent for breaking load and bursting strength shall be taken for all routine testing.

#### 4. SAMPLING

**4.1** The pieces shall be sampled from each lot for determination of physical characteristics. In order that the pieces selected are representative of the lot, they shall be distributed over the bales in the lot. Unless otherwise agreed to between the buyer and the seller, the number of bales to be taken from a lot for the purpose shall depend upon the size of the lot and be in accordance with Table 2.

**TABLE 2 NUMBER OF BALES TO BE CHOSEN FROM A LOT**

LOT SIZE	NO. OF BALES TO BE SELECTED
2 to 8	2
9 to 15	3
16 to 25	5
26 and above	8

**4.2** The bales shall be selected at random from the lot and in order to ensure the randomness of the selection of the bales the following procedure shall be adopted.

**4.2.1** A set of random numbers from 1 to 100 is given in Table 3. Any one numeral shall be selected at random from the table. Starting from the selected numeral and continuing on with the numerals in any direction, right or left, up or down, the succeeding numerals shall be copied out one by one till the number of numerals is equal to the number of bales to be chosen. The numerals which are greater than the size of the lot or which have already occurred shall be omitted. The numerals noted down in this manner shall be arranged in the ascending order of magnitude.

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**TABLE 3 RANDOM NUMBER TABLE**

81	74	67	95	70	56	51	54	50	53
61	37	42	62	93	96	34	18	22	88
52	07	16	29	39	04	71	14	76	78
43	08	77	25	72	49	86	03	83	45
65	32	27	40	63	57	97	84	82	87
21	58	11	23	80	10	30	01	100	44
31	90	55	88	13	36	24	91	19	64
73	98	20	05	68	46	69	85	94	59
33	15	35	26	79	92	38	12	41	17
75	66	99	09	06	47	48	60	28	02

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**4.2.2** Starting from any bale in the lot and counting them in one order, the bales corresponding to numerals already noted down shall be selected from the lot for drawing samples.

**4.3** From each selected bale approximately equal number of pieces shall be chosen at random.

**4.3.1** The minimum number of pieces to be selected from any bale shall be determined by dividing the number of tests to be conducted (*see* Table 1) by the number of bales selected (*see* Table 2). If it comes out to be a fractional number, its maximum integral part (say  $l$ ) shall be taken and  $l$  or  $(l+1)$  pieces shall be chosen from each selected bale so as to get the requisite number of pieces for tests. In case the minimum number of tests happens to be five and the number of bales selected to be eight, one or more pieces shall be taken from each bale so as to get ten pieces for test purposes.

**4.4** From each of the pieces selected, one test specimen shall be taken for determining the various characteristics. While drawing the test specimens care shall be taken to exclude a suitable length from both ends of the piece.

**4.5** The test specimens thus selected shall be subjected to relevant tests for determining the different characteristics.

### 5. CRITERIA FOR CONFORMITY

**5.1** For ascertaining the conformity of the lot to the specification requirements, the following procedure shall be adopted.

**5.1.1** *For One-Sided Specification Limit*—The lot shall be declared as conforming to the specification if:

- a) the value of the expression  $(\bar{x} + kR)$  or  $(\bar{x} + k\bar{R})$  is less than or equal to  $U$ , when the upper specification limit  $U$  is given; or
- b) the value of the expression  $(\bar{x} - kR)$  or  $(\bar{x} - k\bar{R})$  is greater than or equal to  $L$ , when the lower specification limit  $L$  is given;

where the values of the factor  $k$  are given in Table 4 for different sample sizes, and  $U$  and  $L$  refer to the specification limits for individual test results.

**5.1.2** *For Two-Sided Specification Limits*—The lot shall be declared as conforming to the specification if:

- a) the value of the expression  $R/(U - L)$  or  $\bar{R}/(U - L) \leq B$ ;
- b) the value of the expression  $(\bar{x} + kR)$  or  $(\bar{x} + k\bar{R}) \leq U$ ; and
- c) the value of the expression  $(\bar{x} - kR)$  or  $(\bar{x} - k\bar{R}) \geq L$ ;

where the value of factors  $B$  and  $k$  are given in Table 4 for different sample sizes, and  $U$  and  $L$  refer to the specification limits for individual test results.

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**TABLE 4 VALUES OF THE FACTORS**

( Clauses 5.1.1 and 5.1.2 )

SAMPLE SIZE ( $n$ )	$k$	$B$
5	0.3	1.0
10	0.4	0.9
15 and above	0.5	0.8

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### 6. ILLUSTRATIVE EXAMPLE

**6.1** A seller delivers to a buyer a consignment consisting of 50 bales, of which 20 bales consist of cotton umbrella cloth (waterproof) and the remaining 30 bales consist of cotton drill (non-waterproof) for umbrella. The buyer desires to ascertain the conformity of the fabrics supplied to the specification requirements of  $130 \begin{smallmatrix} +6.5 \\ -3.2 \end{smallmatrix} \text{ g/m}^2$  and  $150 \begin{smallmatrix} +6.5 \\ -3.2 \end{smallmatrix} \text{ g/m}^2$  respectively with regard to weight per square metre.

For the purpose of sampling and testing, the consignment shall be divided into two lots (*see* 2.8), one consisting of 20 bales of waterproof

umbrella cloth and other of 30 bales of non-waterproof drill. The weight per square metre of the fabric shall be determined for each lot separately. The procedure for selecting the sample and determining the conformity is explained below with reference to the first lot only, a similar procedure to be followed in case of the second lot also.

The number of bales to be chosen from the lot containing 20 bales for drawing the specimens for test shall be 5 according to Table 2. In order to select the 5 bales at random from 20 bales in the lot, random numbers as given in Table 3 shall be used. Suppose the numeral 03 occurring in the fourth row and eighth column is chosen at random. Proceeding further in any direction, say right, and enumerating the numerals which are not greater than 20, the numerals encountered are 03, 11, 10, 01, 13. Arranging them in ascending order, the sequence 1, 3, 10, 11, 13 is obtained. Then, starting from any bale, the bales in the lot shall be counted in one order and the bales corresponding to these numbers shall be withdrawn from the lot for selecting the pieces from them.

According to 3.2 and Table 1, ten tests corresponding to four percent error shall be required for determination of the weight per square metre of the fabric in the lot. Since the number of bales selected is 5, two pieces shall be chosen from each bale for carrying out the tests.

Let the test results (in  $\text{g/m}^2$ ) be as follows:

132, 134, 131, 129, 133, 135, 132, 128, 130, 134.

The mean ( $\bar{x}$ ) of the test results is then obtained as,

$$(\bar{x}) = \frac{132 + 134 + \dots + 134}{10} = (1318/10) = 131.8 \text{ g/m}^2.$$

The mean range ( $\bar{R}$ ) of the test results shall be calculated by taking the ranges of the first five and the last five test results. Thus,

$$\bar{R} = \frac{5 + 7}{2} = 6 \text{ g/m}^2.$$

Now the weight per square metre has been specified to be  $130^{+6.5}_{-3.2} \text{ g/m}^2$  thereby leading to the lower ( $L$ ) and upper ( $U$ ) specification limits of 126.8 and 136.5  $\text{g/m}^2$  respectively. According to 5.1.2, it is then found that:

a) the values of the expression  $\frac{\bar{R}}{U-L}$  comes out to be  $\frac{6}{9.7} = 0.62$

which is less than 0.9 the value of  $B$  given in Table 4 for sample size 10,

b) the value of the expression  $(\bar{x} - k\bar{R})$  comes out to be  $(131.8 + 0.4 \times 6) = 134.2 \text{ g/m}^2$  which is less than the upper specification limit of 136.5  $\text{g/m}^2$ , and

- c) the value of the expression  $(\bar{x} - k\bar{R})$  comes out to be  $(131.8 - 0.4 \times 6) = 129.4 \text{ g/m}^2$  which is greater than the lower specification limit of  $126.8 \text{ g/m}^2$ .

Hence the lot consisting of cotton umbrella cloth (waterproof) shall be declared as conforming to the specification requirements in respect of weight per square metre.

## APPENDIX A

(Clauses 2.9, 2.12, 2.13 and 5)

### GLOSSARY OF SYMBOLS

$\bar{x}$  Mean; if  $x_1, x_2, \dots, x_n$  are the  $n$  measurements of the items in a sample then  $\bar{x} = \frac{x_1 + x_2 + \dots + x_n}{n}$

$R$  Range; if  $x_1, x_2, \dots, x_n$  are the  $n$  measurements of items in a sample, arranged in the ascending order of magnitude, then  $R = x_n - x_1$

$\bar{R}$  Mean Range; if  $R_1, R_2, \dots, R_m$  are the ranges of  $m$  subgroups of five observations each (so that sample size  $n = 5m$ ) then,

$$\bar{R} = \frac{R_1 + R_2 + \dots + R_m}{m}$$

$k$  Coefficient of  $R$  or  $\bar{R}$  for the criteria for conformity.

$B$  Maximum value for the expression  $\frac{R}{U-L}$  or  $\frac{\bar{R}}{U-L}$  in criteria for conformity for two-sided specification limits.

$U$  Upper specification limit

$L$  Lower specification limit

$\leq$  Less than or equal to

$\geq$  Greater than or equal to

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